

WHAT IS CLAIMED IS

1. An image pickup apparatus comprising:

a sample stage for moving a sample whose image is to be picked up in a first direction;

an illumination light source for projecting illumination light on the sample;

a first spatial filter arranged between the illumination light source and sample and having a plurality of slits formed at a predetermined pitch along the first direction and extending in a second direction perpendicular to said first direction;

an image sensor for receiving reflected light or transmitted light from the sample, having a plurality of light receiving elements arranged in a two-dimensional array along said first and second directions, successively transferring the charges stored in one line of light receiving elements arranged in the second direction for each line at a predetermined transfer speed, and successively outputting the charges stored in the light receiving elements;

a second spatial filter arranged between the sample stage and the second image sensor and having a plurality of slits formed at a predetermined pitch along the first direction and extending in the second direction;

an objective lens arranged between said sample stage and second spatial filter and forming an image of transmitted light or reflected light from the sample on the image sensor via the slits of the second spatial filter; and

a drive control circuit for controlling the charge transfer speed of the image sensors and speed of movement of the sample stage;

the first and second spatial filters being arranged so that light emitted from the slits of the first spatial filter strikes the sample and the image sensor through the slits of the second spatial filter;

the speed of movement of the sample stage and the charge transfer speed of the image sensor being set so that the time interval during which the sample moves from the position which the illumination light passing through an i -th slit of the first spatial filter strikes to the position which the illumination light passing through the adjoining $i+1$ th slit strikes and the time interval during which the charges stored in the line of light receiving elements, of the image sensor, which the light passing through the i -th slit of the second spatial filter strikes are transferred to the line of light receiving elements which the illumination light passing through the adjoining

i+1st slit strikes become equal to each other.

2. An image pickup apparatus as set forth in claim 1, further comprising a position detection device for detecting a position of the sample stage in the first direction, said drive control circuit adjusting the charge transfer speed of said image sensor based on the stage position signal from said position detection device.

3. An image pickup apparatus comprising:

a sample stage for moving a sample whose image is to be picked up in a first direction;

a first light source for projecting illumination light for picking up a transmitted image of a sample;

a second light source for projecting illumination light for picking up a reflected image of a sample;

a first spatial filter arranged between said first light source and the sample stage and having a plurality of slits formed at a predetermined pitch along said first direction and extending in a second direction perpendicular to said first direction;

a second spatial filter arranged between said second light source and the sample stage and having a plurality of slits formed at a predetermined pitch along the first direction and extending in the second direction perpendicular to the first direction;

a first image sensor for receiving light generated from said first light source and passing through the sample, having a plurality of light receiving elements arranged in a two-dimensional array along said first and second directions, successively transferring the charges stored in one line of light receiving elements arranged in the second direction for each line at a predetermined transfer speed, and successively outputting the charges stored in the light receiving elements;

a second image sensor for receiving light generated from said second light source and reflected at the sample, having a plurality of light receiving elements arranged in a two-dimensional array along said first and second directions, successively transferring the charges stored in one line of light receiving elements arranged in the second direction for each line at a predetermined transfer speed, and successively outputting the charges stored in the light receiving elements;

a third spatial filter arranged between said sample stage and first image sensor and having a plurality of slits formed at a predetermined pitch along the first

direction and extending in the second direction;

a fourth spatial filter arranged between said sample stage and second image sensor and having a plurality of slits formed at a predetermined pitch along the first direction and extending in the second direction;

an objective lens arranged between said sample stage and third and fourth spatial filters and forming an image of transmitted light and reflected light from the sample on the first and second image sensors via the slits of the third and fourth spatial filters; and

a drive control circuit for controlling the charge transfer speed of the first and second image sensors and speed of movement of the sample stage;

the first spatial filter and third spatial filter being arranged so that illumination light emitted from the slits of the first spatial filter strike the first image sensor through the sample, the objective lens and the slits of the third spatial filter;

the second spatial filter and fourth spatial filter being arranged so that illumination light emitted from the slits of the second spatial filter strike the second image sensor through the sample, the objective and the slits of the fourth spatial filter;

the speed of movement of the sample stage and the charge transfer speed of the first and second image sensors being set so that the time interval during which the sample moves from the position which the illumination light passing through an i -th slits of the first and second spatial filters strikes to the position which the illumination light passing through the adjoining $i+1$ th slits strikes and the time interval during which the charges stored in the line of light receiving elements, of the image sensors, which the light passing through the i -th slits of the third and fourth spatial filters strikes are transferred to the line of light receiving elements which the illumination light passing through the adjoining $i+1$ st slits strikes become equal to each other.

4. An image pickup apparatus as set forth in claim 3, wherein said first and second light sources generate illumination light of same wavelengths and said third and fourth spatial filters are arranged so that the transmitted light from the sample strikes the light blocking portions between slits of the fourth spatial filter and the reflected light from the sample strikes the light blocking portions between the slits of the third spatial filter.

5. An image pickup apparatus as set forth in claim 3, wherein the

wavelength of the illumination light generated from said first light source and the wavelength of the illumination light generated from the second light source are made different from each other and a separation element for separating the transmitted light and reflected light from the sample is arranged between the sample and the third and fourth spatial filters.

6. An image pickup apparatus comprising:

a sample stage for moving a sample whose image is to be picked up in a first direction;

a light source for generating a light beam;

a diffraction grating for generating n number of sub beams at predetermined intervals along a direction corresponding to said first direction from said light beam;

a beam deflection device for cyclically deflecting said sub beams by a predetermined frequency in a second direction perpendicular to said first direction;

an image sensor for receiving reflected light or transmitted light from a sample, having a plurality of light receiving elements arranged in a two-dimensional array along said first and second directions, successively transferring the charges stored in one line of light receiving elements arranged in the second direction for each line at a predetermined transfer speed, and successively outputting the charges stored in the light receiving elements;

a spatial filter arranged between the sample stage and image sensor and having a plurality of slits formed at a predetermined pitch along the first direction and extending in the second direction;

an objective lens arranged forming an image of transmitted light or reflected light from the sample on the image sensor via the slits of the second spatial filter;

and

a drive control circuit for controlling the drive of the image sensor and beam deflection apparatus;

the reflected light or transmitted light of the plurality of sub beams scanning the surface of the sample striking the image sensor through the slits of the spatial filter;

the speed of movement of the sample stage and the charge transfer speed of the image sensor being set so that the time interval during which the sample moves from the position which an i -th sub beam strikes to the position which the adjoining

i+1st sub beam strikes and the time interval during which the charges stored in the line of light receiving elements, of the image sensor, which the light passing through the i-th slit of the spatial filter strikes are transferred to the line of light receiving elements which the illumination light passing through the adjoining i+1st slit strikes become equal to each other.

7. An image pickup apparatus comprising:

a sample stage for moving a sample whose image is to be picked up in a first direction;

a light source for generating illumination light for picking up a transmitted image;

a first spatial filter arranged between the illumination light source and sample and having a plurality of slits formed at a predetermined pitch along said first direction and extending in a second direction perpendicular to said first direction;

a first image sensor for receiving transmitted light from the sample, having a plurality of light receiving elements arranged in a two-dimensional array along said first and second directions, successively transferring the charges stored in one line of light receiving elements arranged in the second direction for each line at a predetermined transfer speed, and successively outputting the charges stored in the light receiving elements;

a second spatial filter arranged between the sample and first image sensor and having a plurality of slits formed at a predetermined pitch along the first direction and extending in the second direction;

a light source for generating a light beam for picking up a reflected image;

a diffraction grating for generating n number of sub beams from the light beam;

a beam deflection device for deflecting the sub beams by a predetermined frequency in a second direction perpendicular to the first direction;

a second image sensor for receiving reflected light from a sample, having a plurality of light receiving elements arranged in a two-dimensional array along said first and second directions, successively transferring the charges stored in one line of light receiving elements arranged in the second direction for each line at a predetermined transfer speed, and successively outputting the charges stored in the light receiving elements;

a third spatial filter arranged between the sample stage and second image sensor and having a plurality of slits formed at a predetermined pitch along the first direction and extending in the second direction;

an objective lens arranged forming an image of transmitted light and reflected light from the sample on the first and the second image sensors via the slits of the second and third spatial filter, respectively; and

a drive control circuit for controlling the drive of the first and second image sensors and beam deflection apparatus;

the first and second spatial filters being arranged so that the light emitted from the slits of the first spatial filter strike the first image sensor through the sample, the object lens and the slits of the second spatial filter;

the third spatial filter being arranged so that the reflected light from the sample strikes the second image sensor through the object lens and the slits of the third spatial filter;

the speed of movement of the sample stage and the charge transfer speed of the first and second image sensors being set so that the time interval during which the sample moves from the position which the i -th sub beam strikes to the position which the adjoining $i+1$ st sub beam strikes and the time interval during which the charges stored in the line of light receiving elements, of the image sensors, which the light passing through the i -th slit of the spatial filter strikes is transferred to the line of light receiving elements which the illumination light passing through the adjoining $i+1$ st slit strikes become equal to each other.

8. An image pickup apparatus comprising:

a sample stage for moving a sample whose image is to be picked up in a first direction;

an illumination light source for projecting illumination light for picking up a transmitted image;

a first spatial filter arranged between the illumination light source and sample and having a plurality of slits formed at a predetermined pitch along said first direction and extending in a second direction perpendicular to said first direction;

a first image sensor for receiving transmitted light from a sample, having a plurality of light receiving elements arranged in a two-dimensional array along said first and second directions, successively transferring the charges stored in one line

of light receiving elements arranged in the second direction for each line at a predetermined transfer speed, and successively outputting the charges stored in the light receiving elements;

a second spatial filter arranged between the sample and first image sensor and having a plurality of slits formed at a predetermined pitch along the first direction and extending in the second direction;

a light source for generating a light beam for picking up a reflected image;

a beam deflection device for deflecting said light beam by a predetermined frequency in a second direction perpendicular to the first direction;

a linear image sensor for receiving the reflected light from said sample, having a plurality of light receiving elements arranged in a line along the second direction, and reading out the charges stored in the light receiving elements in synchronization with the first image sensor;

an objective lens arranged for forming images of transmitted light and reflected light from the sample on the first image sensor and linear image sensor, respectively; and

a drive control circuit for controlling the drive of the first and the linear image sensor and said beam deflection apparatus;

the first and second spatial filters being arranged so that the light emitted from the slits of the first spatial filter strikes the image sensor through the sample, the object lens, and the slits of the second spatial filter;

the speed of movement of the sample stage and the charge transfer speed of the image sensors being set so that the time interval during which the sample moves from the position which the i -th sub beam strikes to the position which the adjoining $i+1$ st sub beam strikes and the time during which the charges stored in the line of light receiving elements, of the image sensors, which the light passing through the i -th slit of the spatial filters strikes are transferred to the line of light receiving elements which the illumination light passing through the adjoining $i+1$ st slit strikes become equal to each other.

9. An image pickup apparatus as set forth in claim 8, wherein said beam deflection apparatus is comprised by an acoustic optical device and the beam deflection frequency of the acoustic optical element is set to a whole multiple (including an equal value) of the charge transfer speed of the first image sensor.

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10. An image pickup apparatus as set forth in any one of claims 6 to 9, wherein each light receiving element of said image sensors has a charge storing ability able to store a charge generated in accordance with light striking it.

11. A photomask defect inspection system comprising:

a stage for moving a photomask to be inspected for defects in a first direction;

an illumination light source for projecting illumination light on the photomask;

a first spatial filter arranged between the illumination light source and stage and having a plurality of slits formed at a predetermined pitch along said first direction and extending in a second direction perpendicular to said first direction;

a first image sensor for receiving transmitted light from the photomask, having a plurality of light receiving elements arranged in a two-dimensional array along said first and second directions, successively transferring the charges stored in one line of light receiving elements arranged in the second direction for each line at a predetermined transfer speed, and successively outputting the charges stored in the light receiving elements;

a second spatial filter arranged between the stage and first image sensor and having a plurality of slits formed at a predetermined pitch along the first direction and extending in the second direction;

a light source for generating a light beam for picking up a reflected image;

a diffraction grating for generating n number of sub beams from the light beam at equal intervals along a direction corresponding to said first direction;

a beam deflection device for cyclically deflecting said sub beams by a predetermined frequency in a second direction perpendicular to said first direction;

a second image sensor for receiving reflected light from the photomask, having a plurality of light receiving elements arranged in a two-dimensional array along said first and second directions, successively transferring the charges stored in one line of light receiving elements arranged in the second direction for each line at a predetermined transfer speed, and successively outputting the charges stored in the light receiving elements;

a third spatial filter arranged between the stage and second image sensor and having a plurality of slits extending in the second direction;

an objective lens for forming an image of transmitted light and reflected light

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from the sample on the first and second image sensors via the slits of the second and third spatial filters;

a drive control circuit for controlling the drive of the first and second image sensors and the beam deflection apparatus; and

a defect detection circuit for detecting defects of the photomask based on the output signals of the first and second image sensors;

the first and second spatial filters being arranged so that the light emitted from the slits of the first spatial filter enter the slits of the second spatial filter;

the third spatial filter being arranged so that the reflected light of the plurality of sub beams scanning the surface of the photomask enter the slits of the third spatial filter;

the charge transfer speed of the first and second image sensors and the speed of movement of the stage being set so that the time interval during which the sample moves from the position which the i -th sub beam strikes to the position which the adjoining $i+1$ st sub beam strikes and the time interval during which the charges stored in the line of light receiving elements, of the image sensor, which the light passing through the i -th slit of the spatial filter strikes are transferred to the line of light receiving elements which the illumination light passing through the adjoining $i+1$ st slit strikes become equal to each other.

12. A photomask defect inspection system comprising:

a stage for moving a photomask to be inspected for defects in a first direction, first and second image pickup apparatuses for picking up an image of the photomask, and a defect detection circuit for detecting defects existing in a photomask based on output signals of the first and second image pickup apparatuses;

each of the first and second image pickup apparatuses being provided with:
an illumination light source for projecting illumination light on the photomask;

a first spatial filter arranged between the illumination light source and stage and having a plurality of slits formed at a predetermined pitch along said first direction and extending in a second direction perpendicular to said first direction;

a first image sensor for receiving transmitted light from the photomask, having a plurality of light receiving elements arranged in a two-dimensional array along said first and second directions, successively transferring the charges stored in one

line of light receiving elements arranged in the second direction for each line at a predetermined transfer speed, and successively outputting the charges stored in the light receiving elements;

a second spatial filter arranged between the stage and first image sensor and having a plurality of slits formed at a predetermined pitch along the first direction and extending in the second direction;

a light source for generating a light beam for picking up a reflected image;

a diffraction grating for generating n number of sub beams from the light beam at equal intervals along a direction corresponding to said first direction;

a beam deflection device for cyclically deflecting said sub beams by a predetermined frequency in a second direction perpendicular to said first direction;

a second image sensor for receiving reflected light from the photomask, having a plurality of light receiving elements arranged in a two-dimensional array along said first and second directions, successively transferring the charges stored in one line of light receiving elements arranged in the second direction for each line at a predetermined transfer speed, and successively outputting the charges stored in the light receiving elements;

a third spatial filter arranged between the stage and second image sensor and having a plurality of slits extending in the second direction;

an object lens for forming an image of transmitted light and reflected light from the sample on the first and second image sensors via the slits of the second and third spatial filters; and

a drive control circuit for controlling the drive of the first and second image sensors and the beam deflection apparatus;

the first and second spatial filters being arranged so that the light emitted from the slits of the first spatial filter enter the slits of the second spatial filter;

the third spatial filter being arranged so that the reflected light of the plurality of sub beams scanning the surface of the photomask enters the slits of the third spatial filter;

the charge transfer speed of the first and second image sensors and the speed of movement of the stage being set so that the time interval during which the sample moves from the position which the i-th sub beam strikes to the position which the adjoining i+1st sub beam strikes and the time during which the charges stored in the

